10. Suppose you are an astronaut in deep space, far from any source of gravity. You have two objects that look identical, but one has a large mass and the other a small mass. How can you tell the difference between the two?
11. Jonathan accelerates away from a stop sign. His eight-year-old daughter sits in the passenger seat. On whom does the back of the seat exert a greater force?
12. The weight of a box sitting on the floor points directly down. The normal force of the floor on the box points directly up. Need these two forces have the same magnitude? Explain.

23. | A 5.0 kg block has an acceleration of 0.20 m/s² when a force is exerted on it. A second block has an acceleration of 0.10 m/s² when subject to the same force. What is the mass of the second block?
A. 10 kg B. 5.0 kg C. 2.5 kg D. 7.5 kg
24. | Tennis balls experience a large drag force. A tennis ball is hit so that it goes straight up and then comes back down. The direction of the drag force is
A. Always up.
B. Up and then down.
C. Always down.
D. Down and then up.
25. | A person gives a box a shove so that it slides up a ramp, then reverses its motion and slides down. The direction of the force of friction is
A. Always down the ramp.
B. Up the ramp and then down the ramp.
C. Always down the ramp.
D. Down the ramp and then up the ramp.

5. An astronaut takes his bathroom scale to the moon and then stands on it. Is the reading of the scale his true weight? Explain.
6. A light block of mass m and a heavy block of mass M are attached to the ends of a rope. A student holds the heavier block and lets the lighter block hang below it, as shown in Figure Q5.6. Then she lets go. Air resistance can be neglected.
   a. What is the tension in the rope while the blocks are falling, before either hits the ground?
   b. Would your answer be different if she had been holding the lighter block initially?

FIGURE Q5.6

7. Four balls are thrown straight up. Figure Q5.7 is a "snapshot" showing their velocities. They have the same size but different mass. Air resistance is negligible. Rank in order, from largest to smallest, the magnitudes of the net forces, F_{net1}, F_{net2}, F_{net3}, F_{net4}, acting on the balls. Some may be equal. Give your answer in the form A > B = C > D, and state your reasoning.

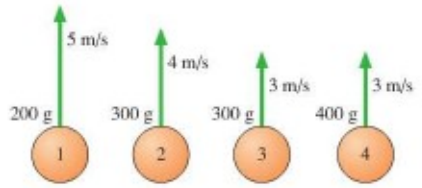

FIGURE Q5.7

14. | A constant force applied to object A causes it to accelerate at 5 m/s². The same force applied to object B causes an acceleration of 3 m/s². Applied to object C, it causes an acceleration of 8 m/s².
   a. Which object has the largest mass?
   b. Which object has the smallest mass?
   c. What is the ratio of mass A to mass B (m_A/m_B)?
15. | Two rubber bands pulling on an object cause it to accelerate at 1.2 m/s².
   a. What will be the object's acceleration if it is pulled by four rubber bands?
   b. What will be the acceleration of two of these objects glued together if they are pulled by two rubber bands?
16. | A constant force is applied to an object, causing the object to accelerate at 10 m/s². What will the acceleration be if
   a. The force is halved?
   b. The object's mass is halved?
   c. The force and the object's mass are both halved?
   d. The force is halved and the object's mass is doubled?
17. | A constant force is applied to an object, causing the object to accelerate at 8.0 m/s². What will the acceleration be if
   a. The force is doubled?
   b. The object's mass is doubled?
   c. The force and the object's mass are both doubled?
   d. The force is doubled and the object's mass is halved?

29. | A football player at practice pushes a 60 kg blocking sled across the field at a constant speed. The coefficient of kinetic friction between the grass and the sled is 0.30. How much force must he apply to the sled?
A. 18 N B. 60 N C. 180 N D. 600 N
30. | Two football players are pushing a 60 kg blocking sled across the field at a constant speed of 2.0 m/s. The coefficient of kinetic friction between the grass and the sled is 0.30. Once they stop pushing, how far will the sled slide before coming to rest?
A. 0.20 m B. 0.68 m C. 1.0 m D. 6.6 m
31. || Land Rover ads used to claim that their vehicles could climb a slope of 45°. For this to be possible, what must be the minimum coefficient of static friction between the vehicle's tires and the road?
A. 0.5 B. 0.7 C. 0.9 D. 1.0
32. || A truck is traveling at 30 m/s on a slippery road. The driver slams on the brakes and the truck starts to skid. If the coefficient of kinetic friction between the tires and the road is 0.20, how far will the truck skid before stopping?
A. 230 m B. 300 m C. 450 m D. 680 m

3. III A 20 kg loudspeaker is suspended 2.0 m below the ceiling by two cables that are each 30° from vertical. What is the tension in the cables?

4. II A 1000 kg steel beam is supported by the two ropes shown in Figure P5.4. Each rope can support a maximum sustained tension of 5600 N. Do the ropes break?

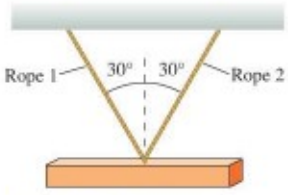

FIGURE P5.4

5. I A cable is used to raise a 25 kg urn from an underwater archeological site. There is a 25 N drag force from the water as the urn is raised at a constant speed. What is the tension in the cable?

44. II Figure P5.44 shows the net force acting on a 2.0 kg object as it moves along the x-axis. The object is at rest at the origin at $t = 0$ s. What are its acceleration and velocity at $t = 6.0$ s?

45. II A 50 kg box hangs from a rope. What is the tension in the rope if
   a. The box is at rest?
   b. The box has $v_y = 5.0$ m/s and is speeding up at 5.0 m/s^2?

46. II A 50 kg box hangs from a rope. What is the tension in the rope if
   a. The box moves up at a steady 5.0 m/s?
   b. The box has $v_y = 5.0$ m/s and is slowing down at 5.0 m/s^2?

47. I Your forehead can withstand a force of about 6.0 kN before fracturing, while your cheekbone can only withstand about 1.3 kN.
   a. If a 140 g baseball strikes your head at 30 m/s and stops in 0.0015 s, what is the magnitude of the ball's acceleration?
   b. What is the magnitude of the force that stops the baseball?
   c. What force does the baseball apply to your head? Explain.
   d. Are you in danger of a fracture if the ball hits you in the forehead? In the cheek?

48. II Seat belts and air bags save lives by reducing the forces exerted on the driver and passengers in an automobile collision. Cars are designed with a "crumple zone" in the front of the car.

11. II The forces in Figure P5.11 are acting on a 2.0 kg object. Find the values of a_x and a_y, the x- and y-components of the object's acceleration.

12. I The forces in Figure P5.12 are acting on a 2.0 kg object. Find the values of a_x and a_y, the x- and y-components of the object's acceleration.

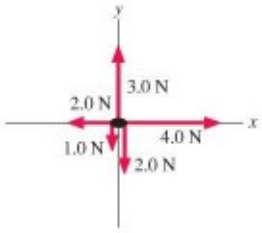

FIGURE P5.12

13. I A horizontal rope is tied to a 50 kg box on frictionless ice. What is the tension in the rope if
   a. The box is at rest?
   b. The box moves at a steady 5.0 m/s?
   c. The box has $v_x = 5.0$ m/s and $a_x = 5.0$ m/s^2?

14. III A crate pushed along the floor with velocity $\vec{v}_i$ slides a distance d after the pushing force is removed.
   a. If the mass of the crate is doubled but the initial velocity is not changed, what distance does the crate slide before stopping? Explain.
   b. If the initial velocity of the crate is doubled to $2\vec{v}_i$ but the mass is not changed, what distance does the crate slide before stopping? Explain.

15. II In a head-on collision, a car stops in 0.10 s from a speed of 14 m/s. The driver has a mass of 70 kg, and is, fortunately, tightly strapped into his seat. What force is applied to the driver by his seat belt during that fraction of a second?

61. III A 1.0 kg wood block is pressed against a vertical wood wall by a 12 N force as shown in Figure P5.61. If the block is initially at rest, will it move upward, move downward, or stay at rest?

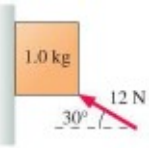

FIGURE P5.61

62. III A 50,000 kg locomotive, with steel wheels, is traveling at 10 m/s on steel rails when its engine and brakes both fail. How far will the locomotive roll before it comes to a stop?

63. II An Airbus A320 jetliner has a takeoff mass of 75,000 kg. It reaches its takeoff speed of 82 m/s (180 mph) in 35 s. What is the thrust of the engines? You can neglect air resistance but not rolling friction.

64. IIII A 2.0 kg wood block is launched up a wooden ramp that is inclined at a 35° angle. The block's initial speed is 10 m/s.
   a. What vertical height does the block reach above its starting point?
   b. What speed does it have when it slides back down to its starting point?